



Carbon Dioxide Capture and Storage : A Compendium of Canadian Organizations and Activities



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**Fifth Annual Conference on
Carbon Capture and Sequestration
Alexandria, Virginia
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Gilles Mercier**

Natural Resources Canada

Outline of Today's Presentation



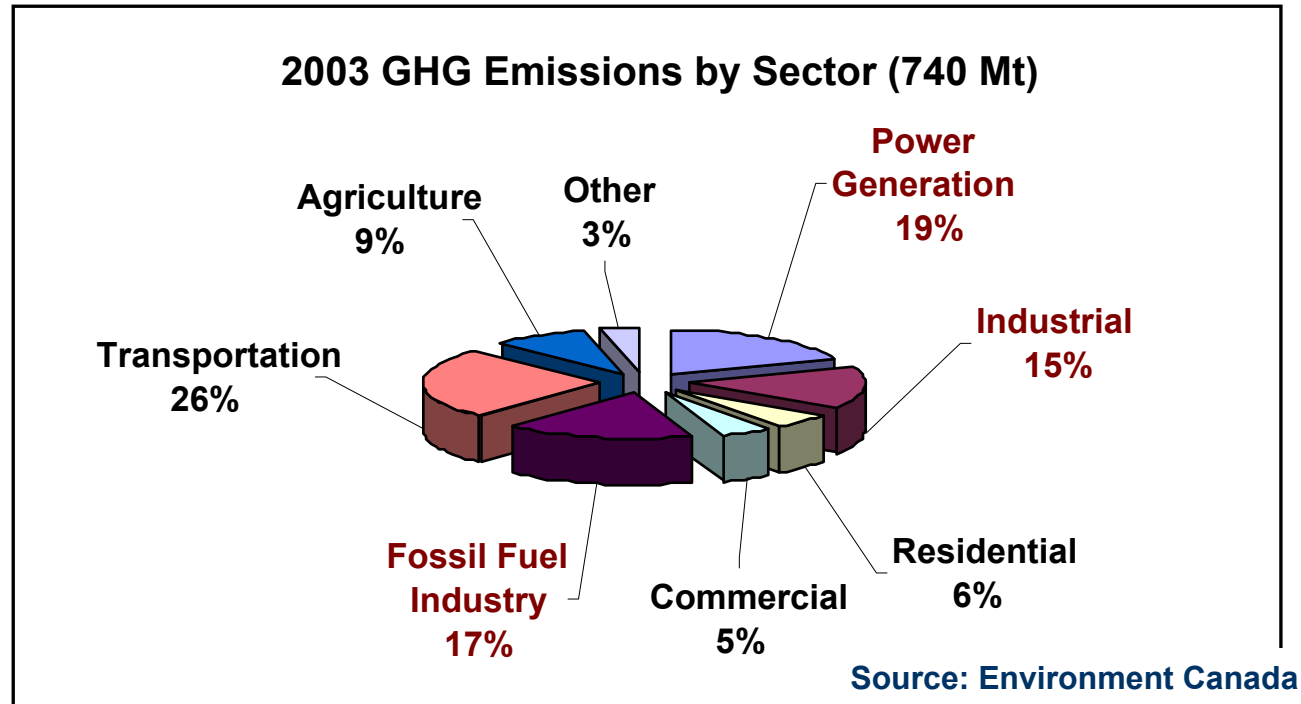
- Towards a sustainable energy economy, role of “transformative” technologies
- Canada’s multi-faceted CO₂ capture and storage (CCS) program – new “Compendium”
- Goals are to encourage dialogue, share of information and experience, and to open up opportunities for learning and collaboration

Achieving a Sustainable Energy Future: Two “Transformative” Actions



- Goal is sustainable development and responsible end-use of Canada's energy resources
 - Energy security, prosperity, environmental and social sustainability
- Many countries are facing issues closely related to supply, conversion and end-use of energy
 - Examples – long-term security of supply, environmental “footprint”, air quality, impact on climate of GHG emissions, foreign energy dependence
- Solutions call for a combination of actions – use less energy, use energy efficiently, accelerate low-carbon technologies and low-impact renewables, capture and store CO₂
- Need both
 - “Transformative” behaviour re how we use energy
 - “Transformative” technologies

Climate Change and the Need to Reduce GHG Emissions is a Formidable Challenge



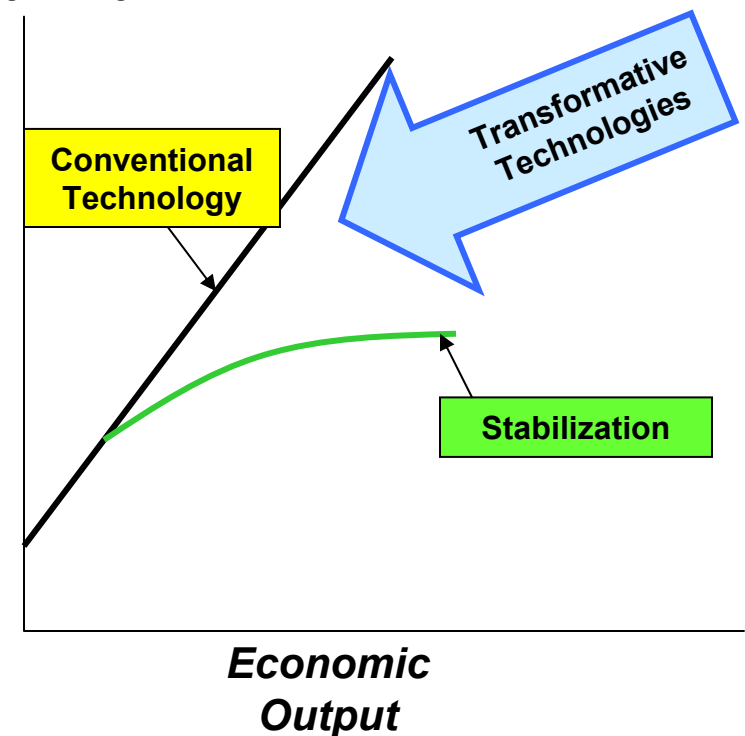
- 51% of Canada's emissions from three sectors
 - power generation (19%), fossil fuel supply (17%), industrial end-use (15%)
- Opportunity for CO₂ capture from large point sources

“Transformative” Energy Technologies Open Up Promising Pathways to Sustainability



- Break the linkage between increased use of energy and many of today’s energy issues
- Fundamentally-different ways of supplying, converting and using energy
- But they require ...
 - new infrastructure, skills, expertise
 - displacement of current technologies
 - new environmental impacts
- And importantly, often trigger public reaction, views - should be addressed up front
- Examples – CO₂ capture and storage, hydrogen , clean coal, zero-net buildings

*Air Quality,
Emissions,
“Foot Print”*



CO₂ Capture and Storage

A Promising Transformative Pathway



- Why are we interested in CO₂ capture, use and storage?
 - Widely applicable to fossil-fueled electricity generation, industrial processes, upstream fossil fuels (including hydrogen production)
 - Canada has excellent geological conditions for storage
 - Makes sustainable use of Canada's energy resources a viable long-term pathway
- Canada has a multi-faceted CCS program underway – towards making CCS a practical reality

Mission: “*Creating the Conditions for a CO₂ Market in Canada*”



Technology, EOR	Regulatory, Communications	Collaboration, Planning
Weyburn-Midale	Storage Regulations	Capacity Building, Transportation
Assessment of Storage Potential	Measurement, Monitoring, Verification	Technology Roadmaps
Enhanced Recovery Oil, Gas	Risk Assessment	Strategic Planning
CO ₂ Capture Technologies	Public Attitudes, Acceptance	International Collaboration Partnerships

After 10 Years, Timely to “Take the Pulse”



- CCS is a key emerging energy technology
- Emerging issues and drivers re CCS
 - Require a sound scientific basis re regulating long-term storage
 - Optimize oil field and coalbed methane development
 - Act on recommendations in two new Technology Roadmaps
- Approach for the Compendium
 - start by assessing what is underway now
 - identify players, scope of activities, investments

CO₂ Capture and Storage

An Innovation System in Full Flight



- Any innovation system is chaotic, non-linear, multi-disciplinary, and evolves rapidly
- The Compendium is a “snapshot” of a diverse, multi-dimensional, busy innovation system
- Looked at ...
 - Players – industry, academia, governments, NGOs
 - All types of activities – research, regulation, awareness, business environment
 - Technologies – capture, transport, storage, monitoring
 - Investments
- Description of currently active or recently completed projects during last three years (2003- 2005)

CO₂ Capture and Storage in Canada

Some Compendium Highlights



- Canada is putting a major effort into CCS
 - 126 projects
 - 83 organizations
 - About \$CDN 340 million in cumulative investments
- Players are dominated by universities, governments, industry
- Funding initially by governments, now dominated by industry
 - Via a few large projects
- Most projects are at feasibility stage, or technology improvement stage

CO₂ Capture and Storage in Canada

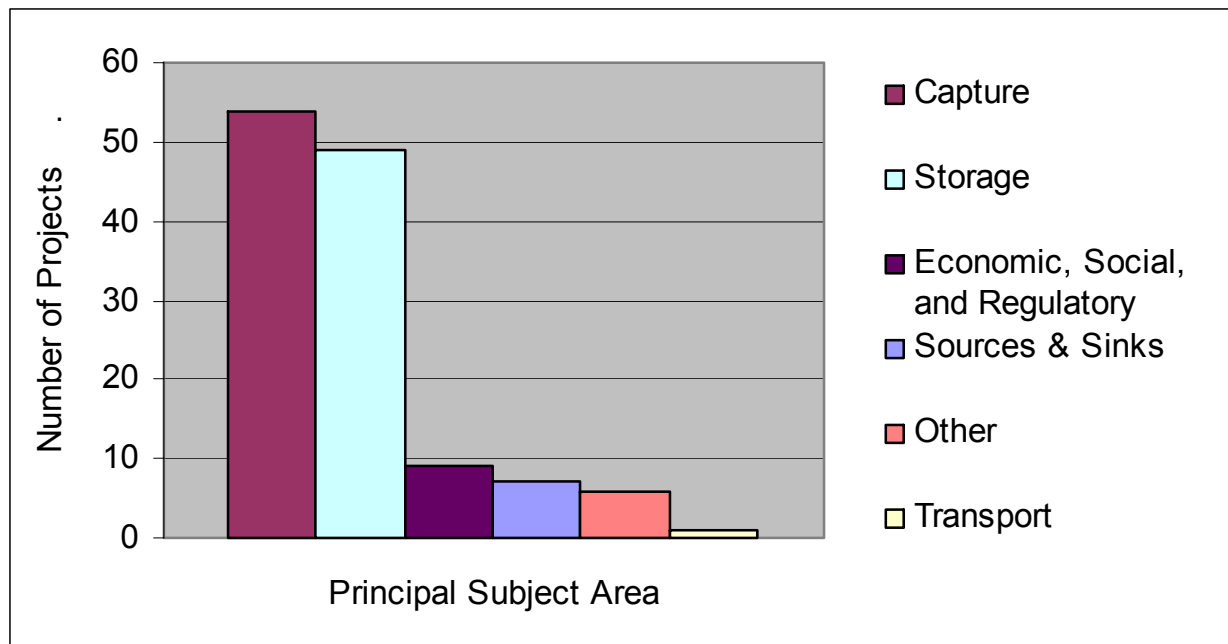
Some Compendium Highlights



- At first, focus on technology, now scope is broadening by adding regulatory, public outreach and business issues
- 13 CCS projects - underway, planning stages
 - 7 EOR – 2 commercial, 4 demonstrations, 1 pending
 - 1 enhanced coalbed methane
 - 4 clean coal with CCS – feasibility, planning stages
 - 1 CO₂ pipeline infrastructure – planning stage

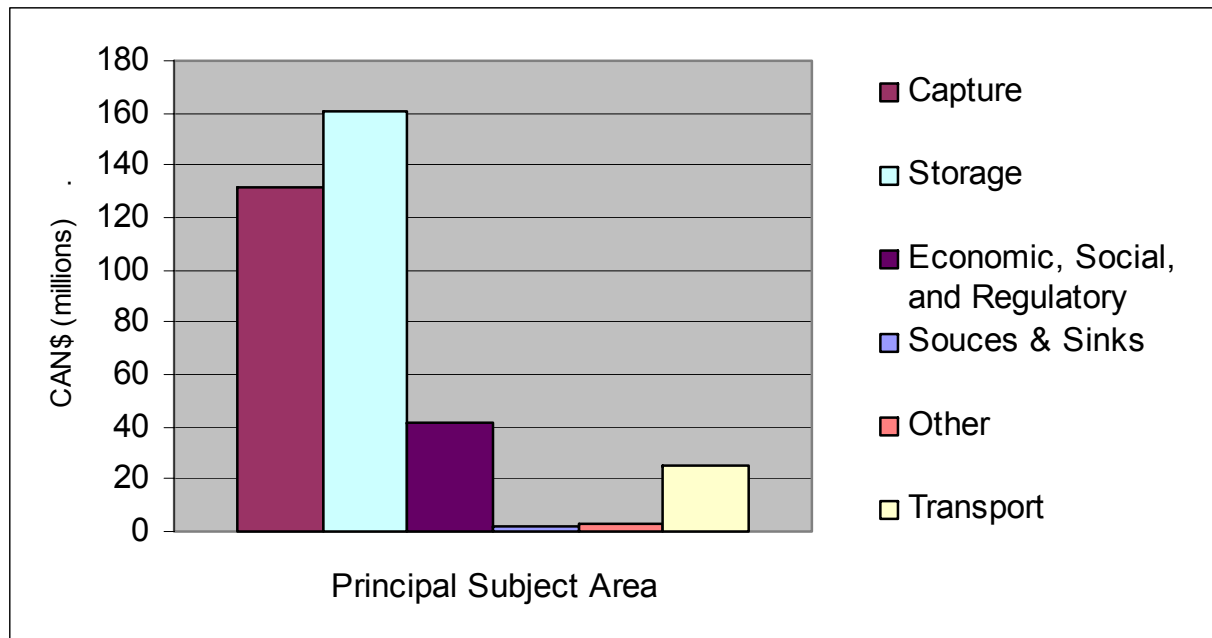
Diverse Suite of CCS Activities

125+ Active, Recently-Completed Projects



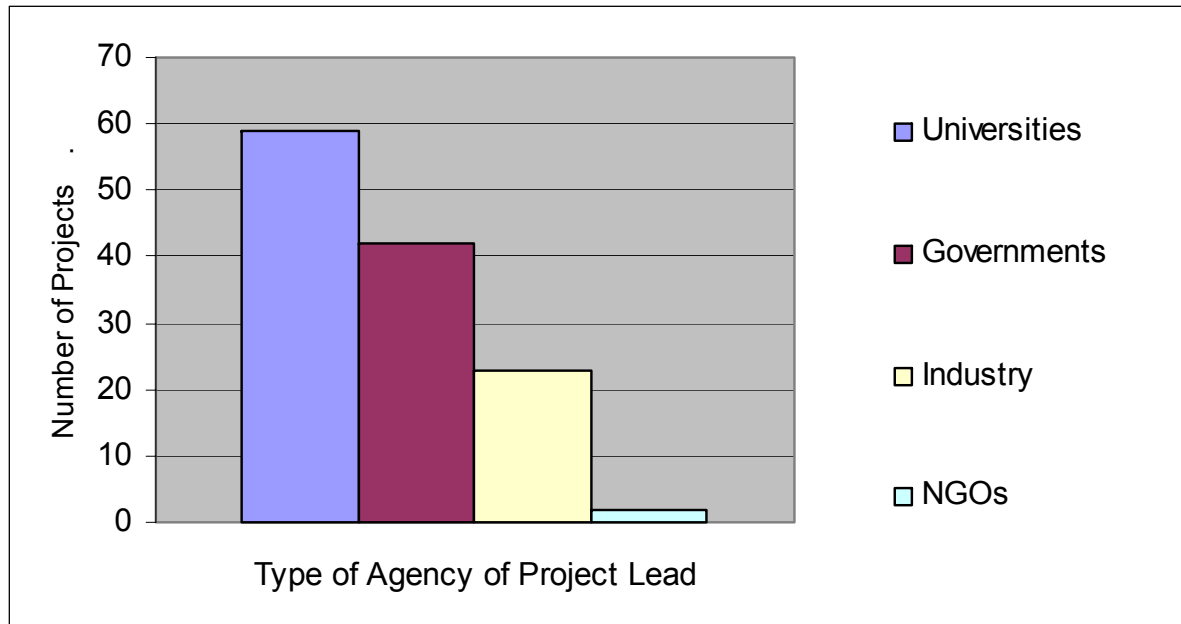
- 126 projects - Most effort to date on capture and geological storage
- Increasing interest in economic, social and regulatory issues in the last few years
- Expected to become more balanced

Investments of \$CDN 340 Million+



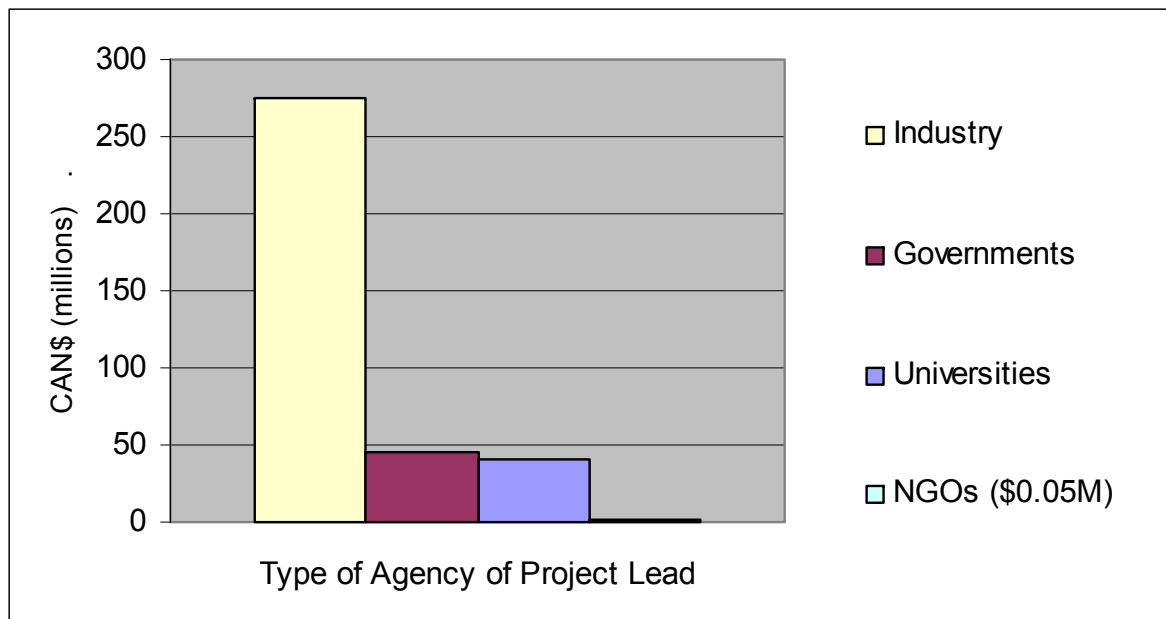
- **Projects active and recently-completed 2003-2005**
- **Largely on capture and geological storage**
- **Investment dominated by large demonstration projects, commercial projects**

Canadian CCS Projects by Lead Organization



- **Universities dominate, then governments and industry**
- **NGOs getting involved**

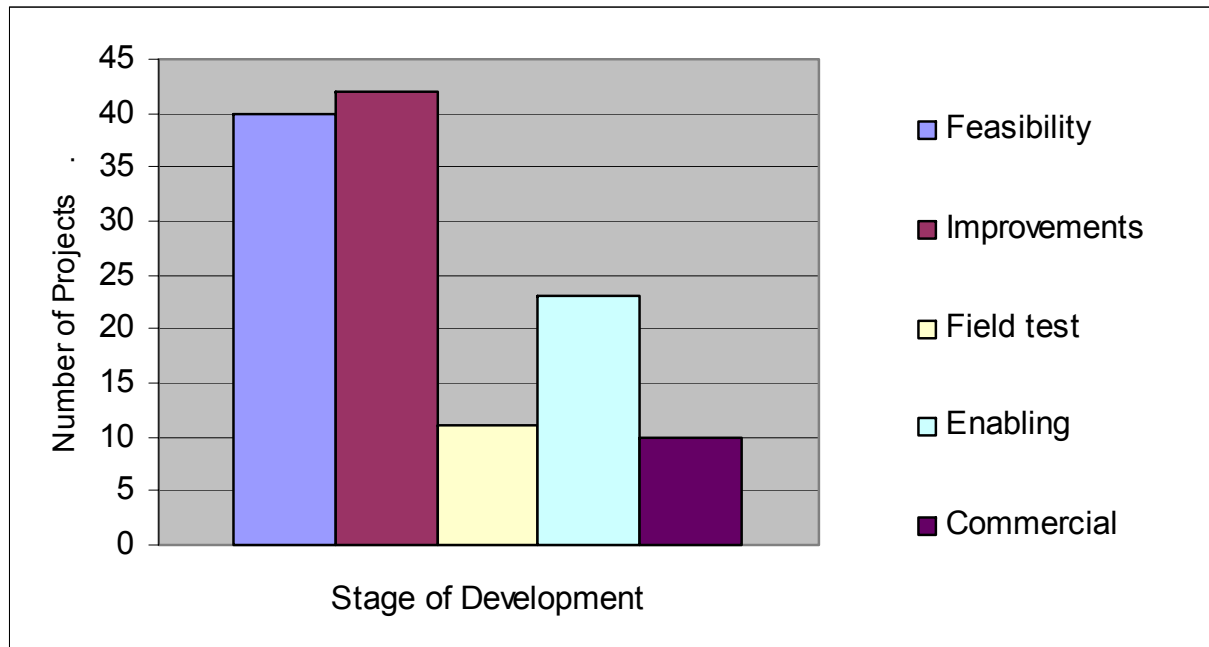
Canadian CCS Projects Investments by Lead Organization



- **Industry dominates financing – mostly EOR, infrastructure and O&M**
- **Governments and universities roughly equal funding**

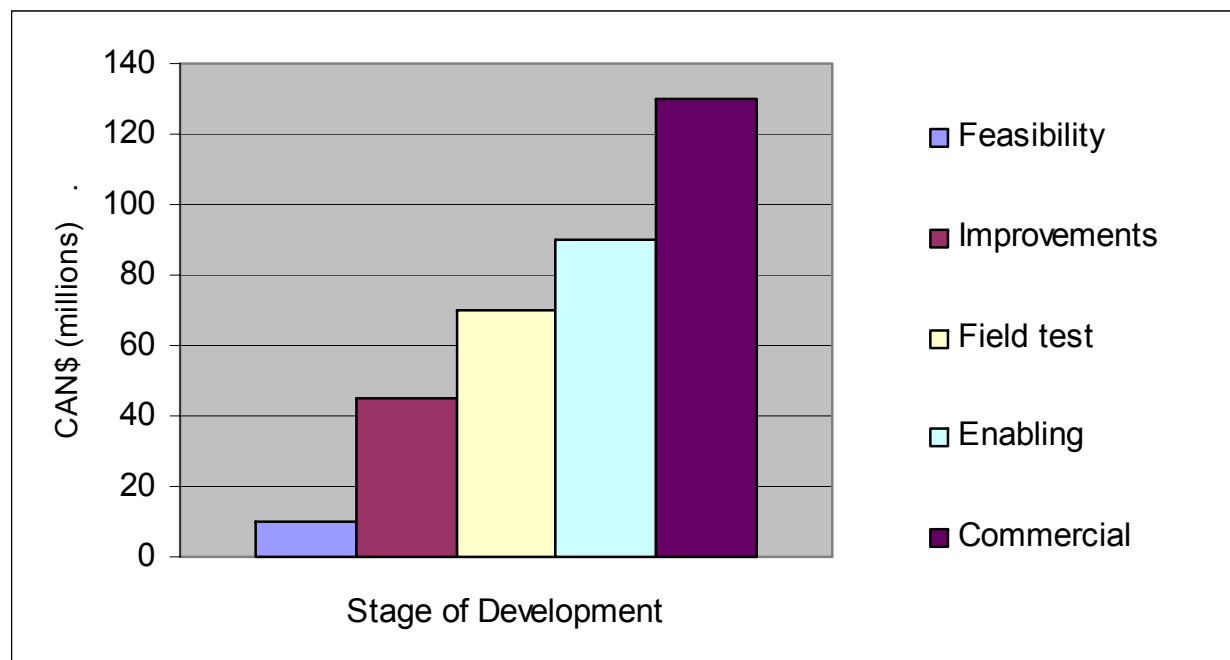
Canadian CCS Projects By Stage of Development

Most Projects in Early Stages of Innovation



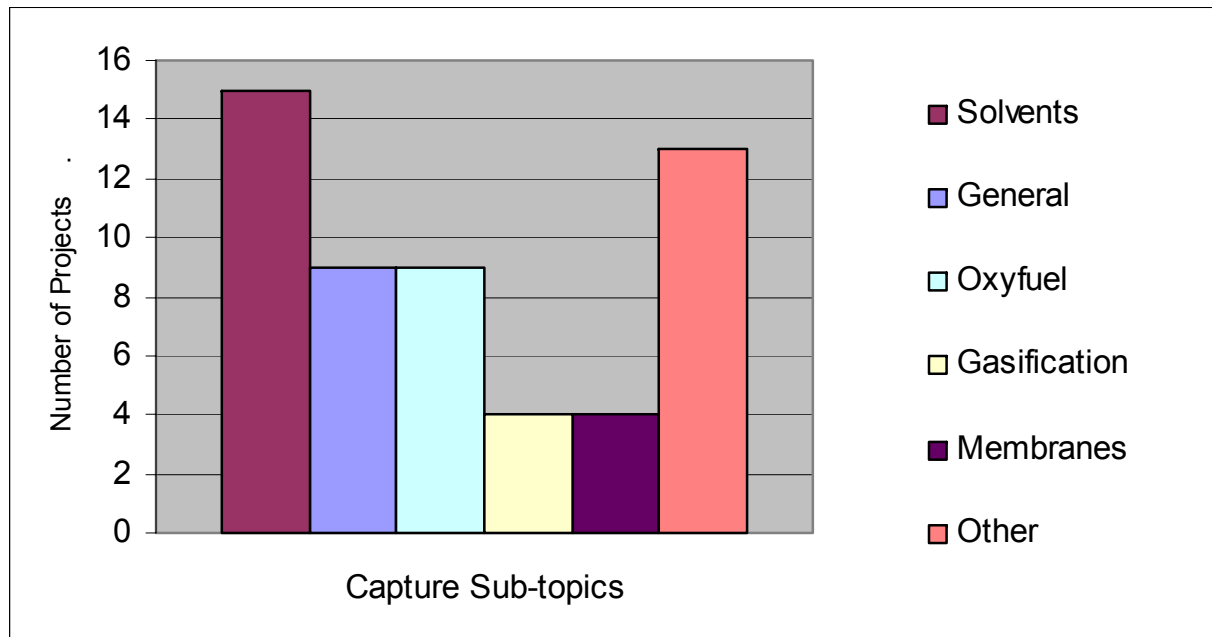
- Large number of projects in the early stage of the innovation spectrum
- Becoming more balanced

Canadian CCS Investments by Stage of Development Most in Demonstration and Commercialization



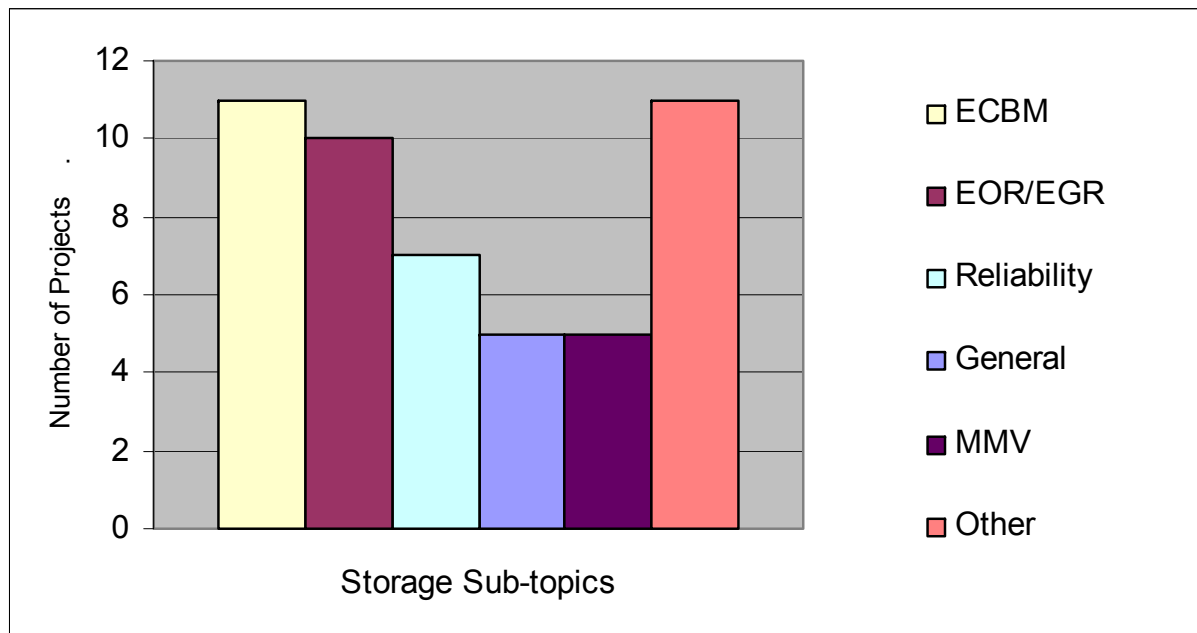
- **Dominated by late stage development and commercialization activities led by the private sector**

CO₂ Capture Projects Wide Range of Technologies



- **Broad coverage across CCS technologies**
- **“General” category: economic and feasibility studies, centre of excellences, etc.**
- **“Other” category: new sorbents, enzymes, fuel cells, etc.**

CO₂ Monitoring, Storage Projects Broad Coverage



- **Enhanced oil recovery and enhanced coalbed methane dominate**
- **“General” category: acid gas injection, geological mapping, etc.**
- **“Other” category: mineral and biological processes, hydrates, etc.**

CO₂ Capture and Storage in Canada

Recent Developments



- Launch of the Final Phase of the IEA GHG Weyburn-Midale CO₂ Monitoring and Storage Project
 - Presentation to follow by Dr. Carolyn Preston re Best Practices Manual, public policy tools, detailed presentation this afternoon
- Discussions underway re CO₂ pipeline infrastructure
- CD-Rom “*Carbon Dioxide Capture and Storage Technology*”
- Report/CD-Rom “*Carbon Dioxide Capture and Storage : A Compendium of Canada’s Participation*”
- Release of “*Canada’s CO₂ Capture and Storage Technology Roadmap*”
- Formation of the Federal Committee on CO₂ Capture and Storage
- Growing interest in industry, research and regulatory communities

What are the Key Messages?



- **CCS is one of Canada's largest efforts in developing "transformative" technologies – a promising pathway to help "break the link" between emissions and economic growth**
- **Scope is broadening – from geoscience and technology at first, to long-term regulatory, communication and business issues**
- **Canadian researchers and industry have developed a comprehensive CCS program**
- **The Compendium and two recent Technology Roadmaps - clean coal and CCS - will orient Canada's future efforts**
- **Call for further coordination to ensure optimized strategic focus, workplans, comprehensive coverage, maximum collaboration between all stakeholders**